

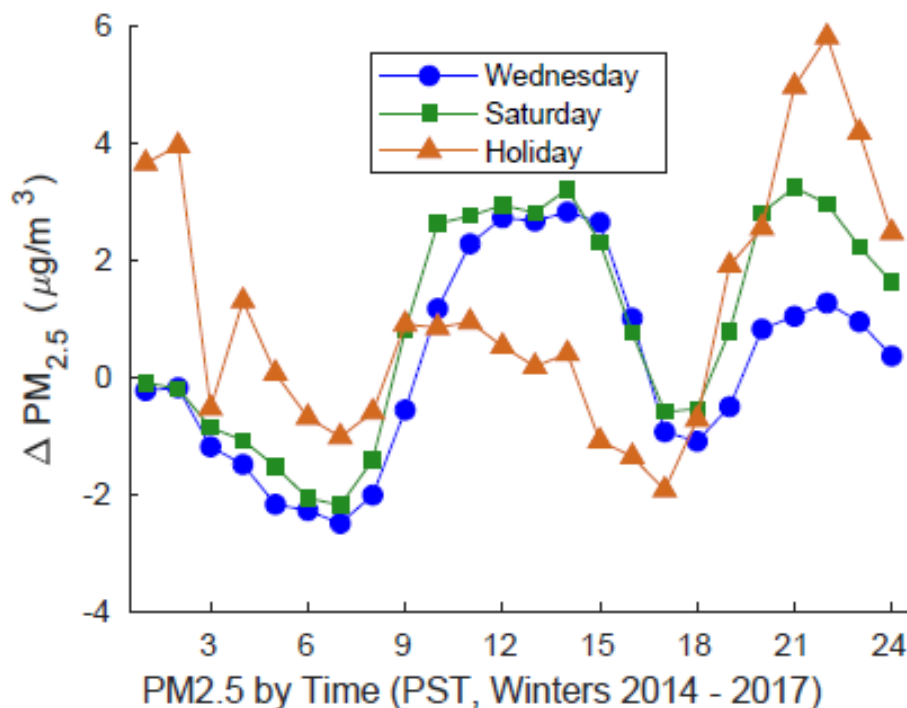
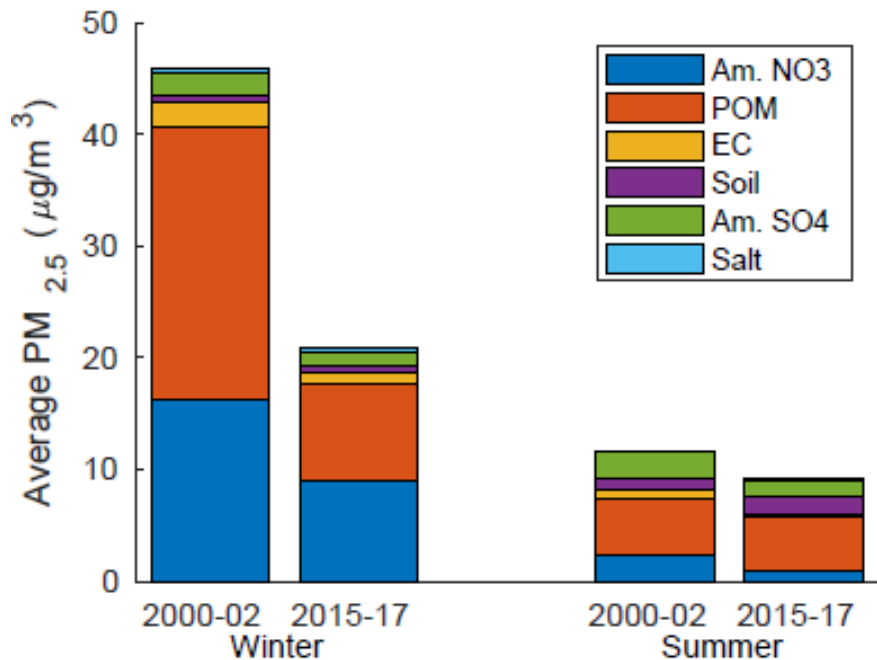
What hourly measurements of NO_x , $\text{PM}_{2.5}$ and O_3 can tell us about how emissions and atmospheric chemistry are changing in the San Joaquin Valley, California

St. Louis Area Monitoring Agencies Meeting

Benjamin de Foy

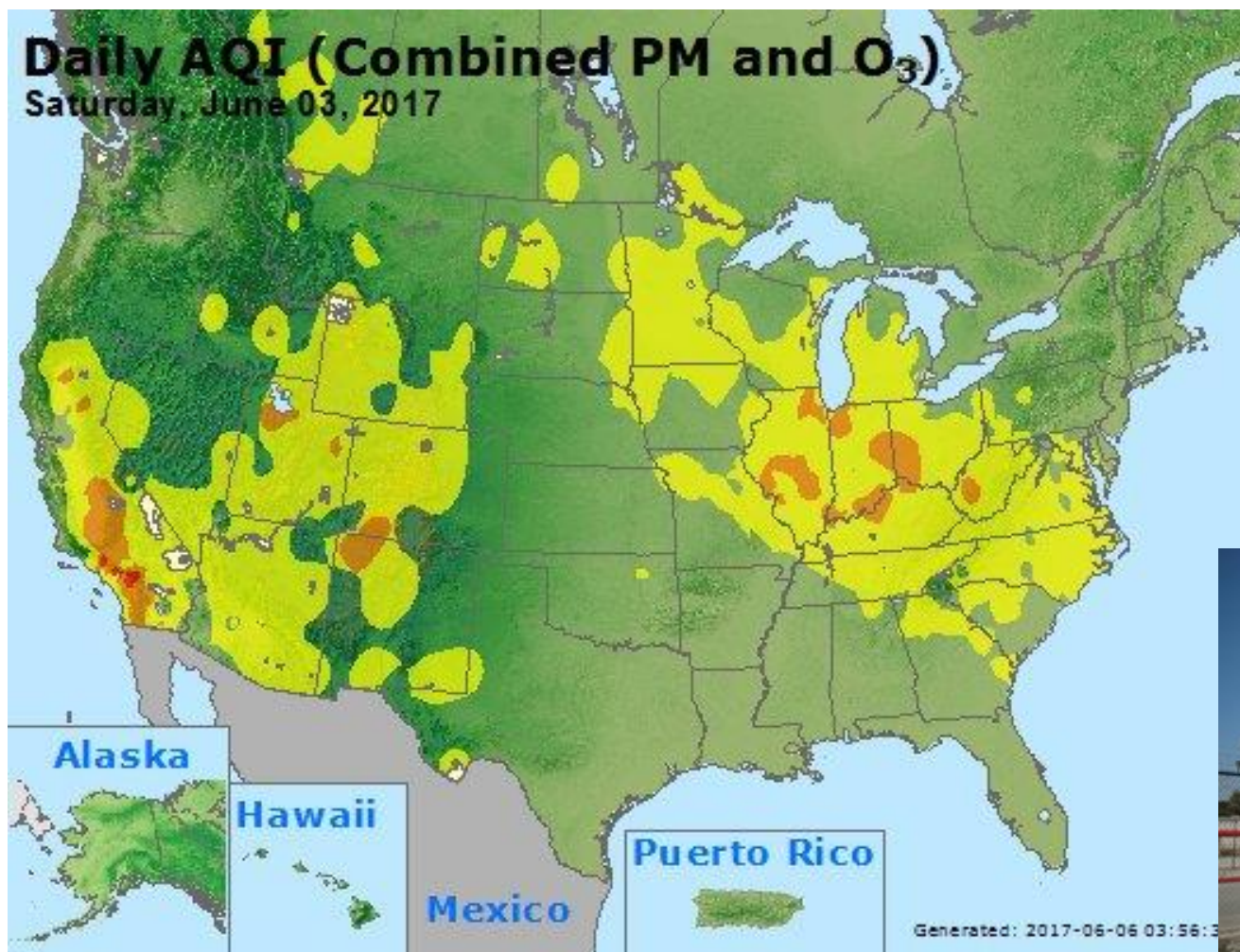
Saint Louis University

21 May 2019

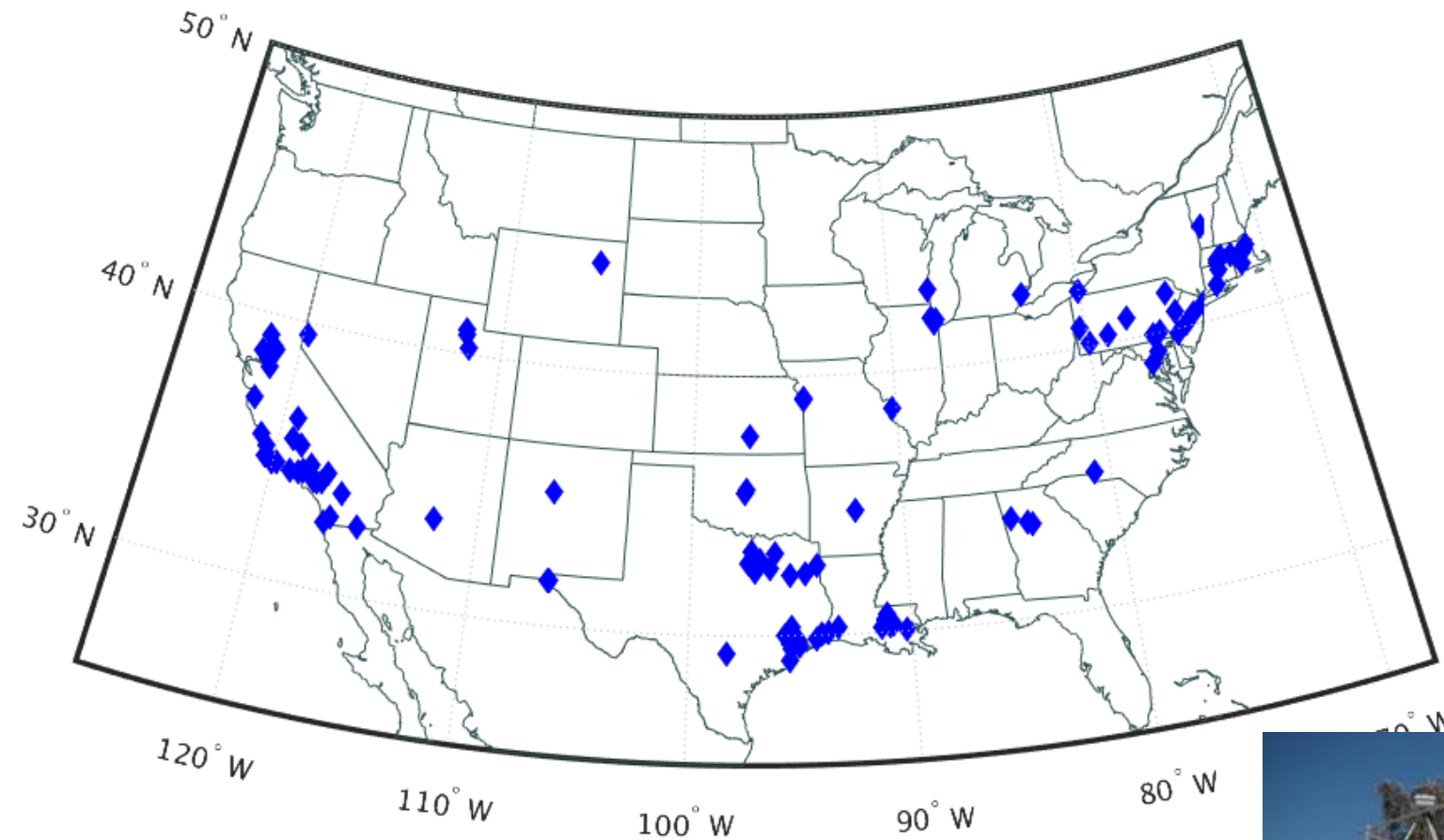




Hourly Air Quality Monitoring at Hundreds of Stations



US-EPA AQS Data Analysis of Hourly NO_x Concentrations



Sites with 90% data for 2005-2015

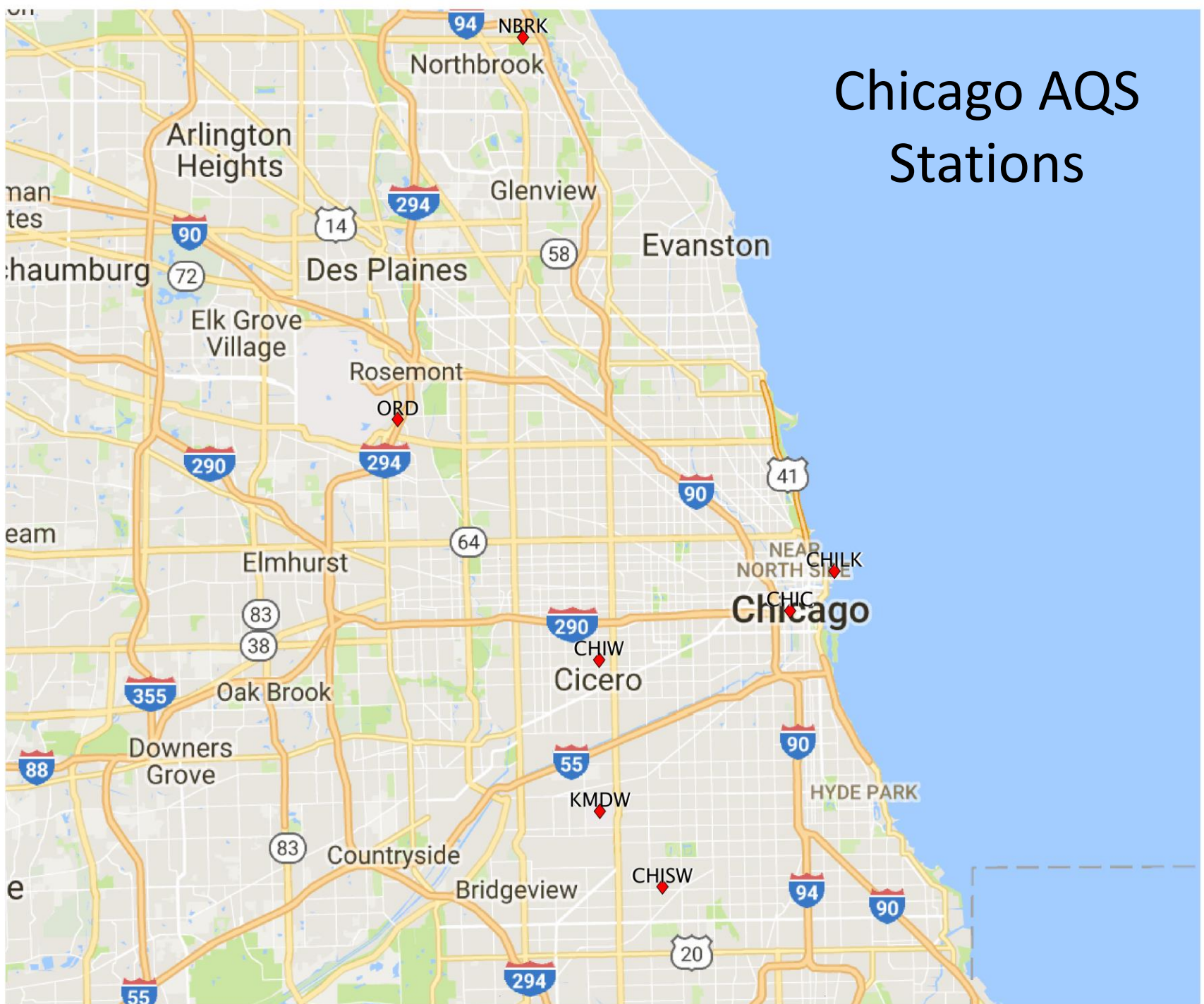


US-EPA AQS Data Analysis: Hourly NO_x Concentrations 2005-2015, 90% data completeness

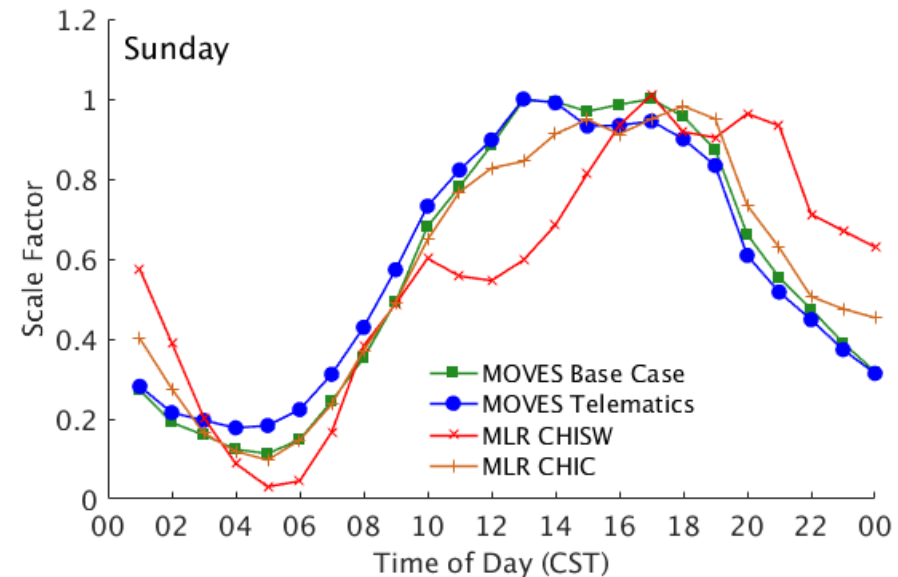
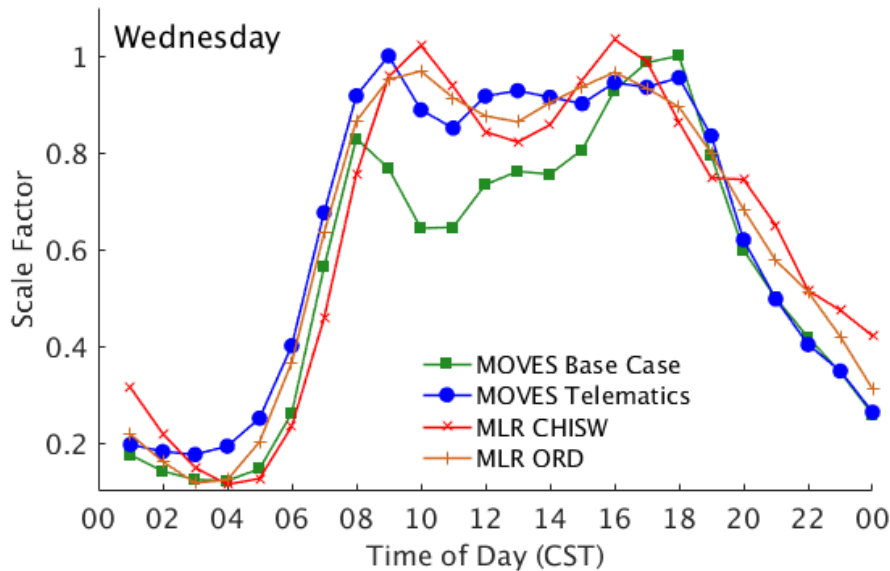
Factors Contributing to NO_x Surface Concentrations:

- **Emissions:** diurnal, weekly, seasonal, long-term signals
- **Transport:** wind speed and direction, boundary layer height
- **Chemistry:** NO_x lifetime: rough proxies: ozone, ultraviolet radiation, temperature, humidity

Chicago AQS Stations



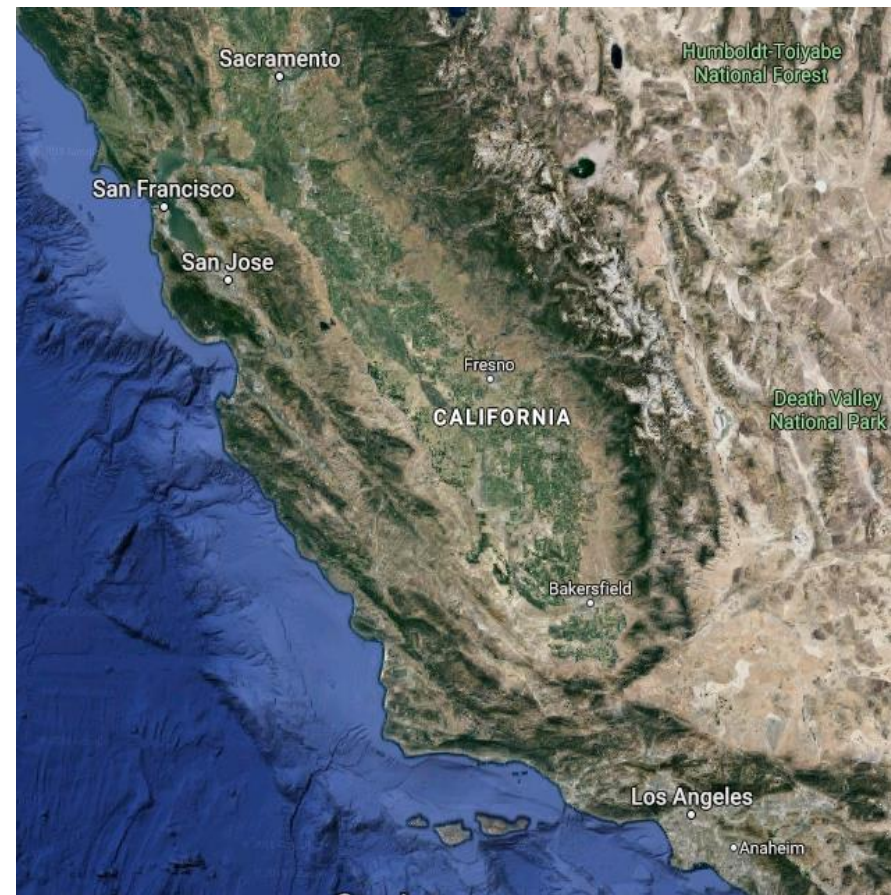
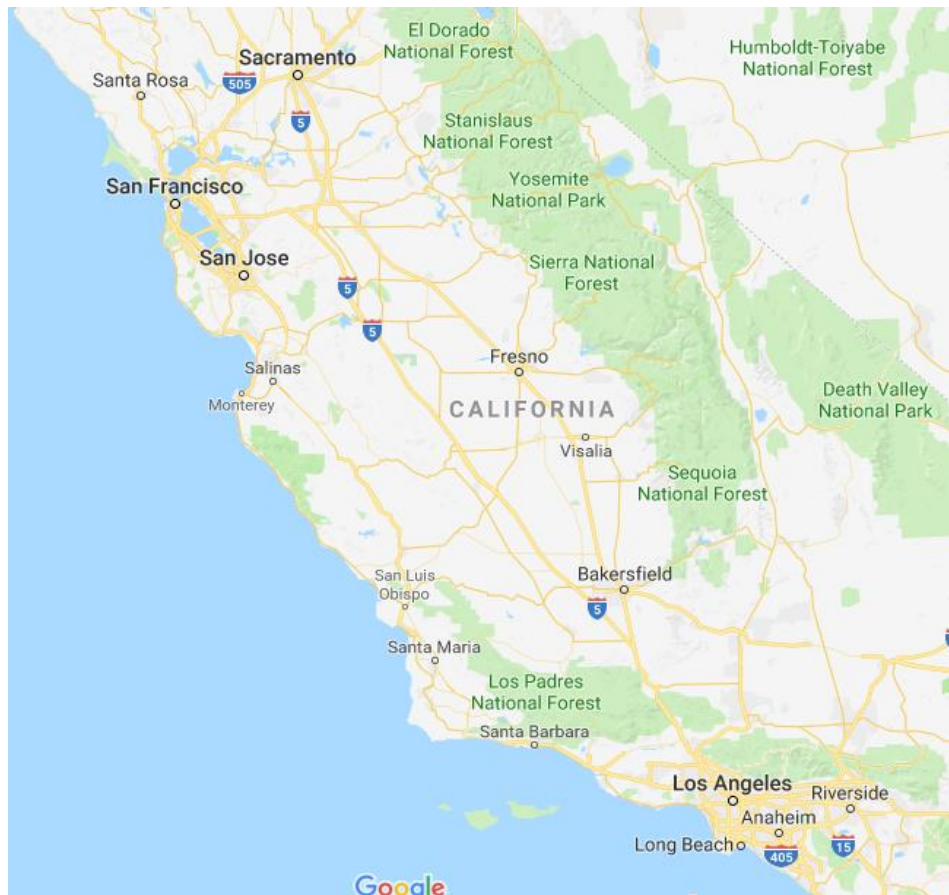
Using both Vehicle Counts and Vehicle Speeds Yields Better Agreement Between NO_x Emissions Inventory and Monitoring Data



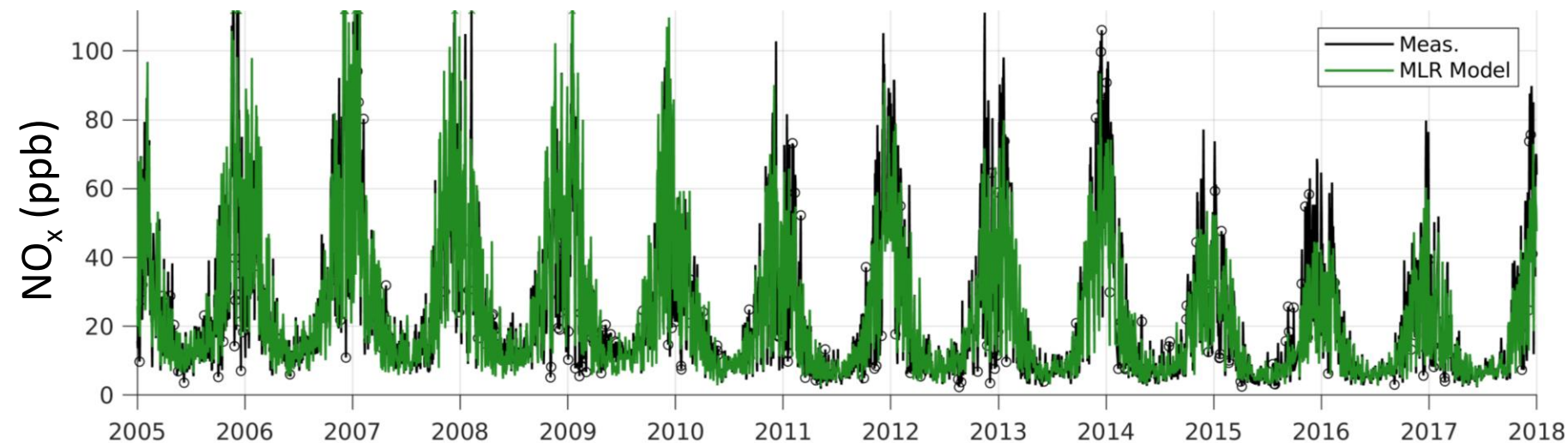
Site Specific Differences Remain,
eg. Southwest Chicago (CHISW) and
Central Chicago (CHIC)

MOVES Profiles from: Eastern Research Group, Inc, February, 2017. Improvement of Default Inputs for MOVES and SMOKE-MOVES. Tech. Rep. A-100. Coordinating Research Council.

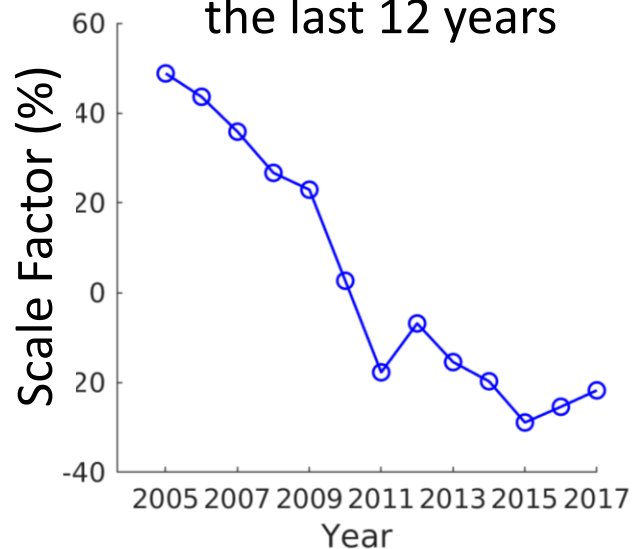
San Joaquin Valley, California



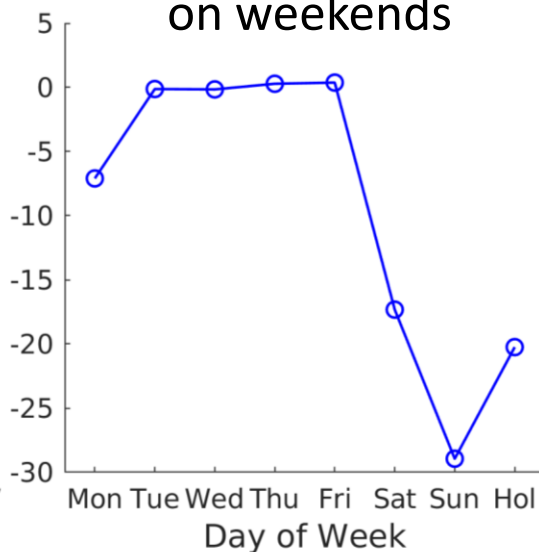
NO_x in Fresno, California: Multilinear Regression Model used to Separate Annual, Seasonal, Weekday and Diurnal Trends



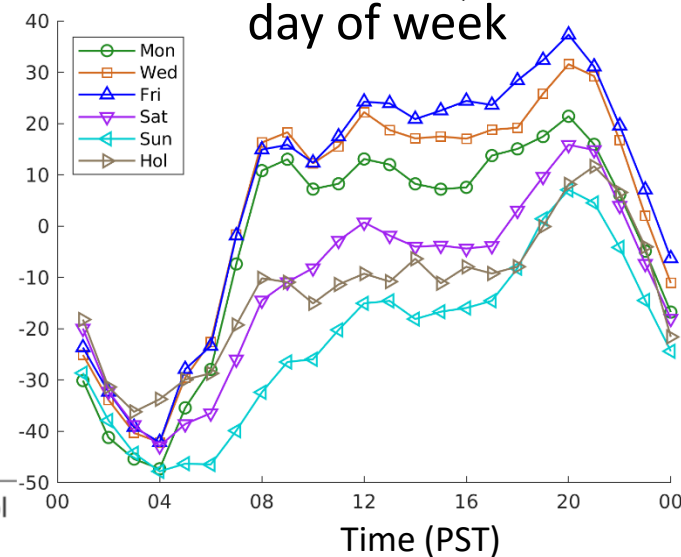
60% reduction over
the last 12 years



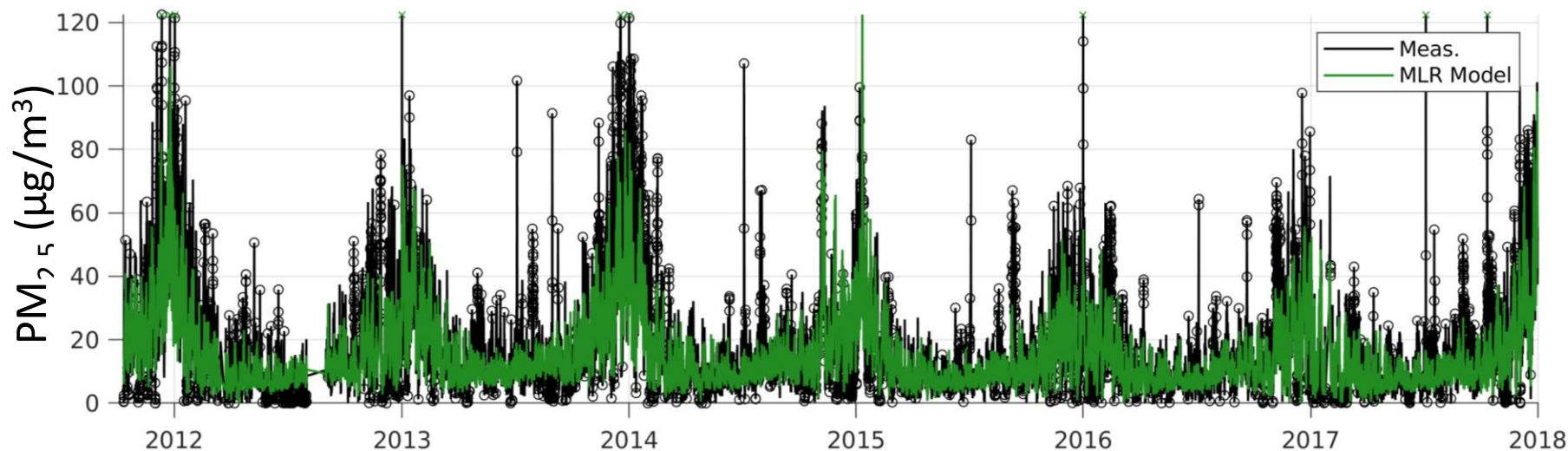
20-30% reductions
on weekends



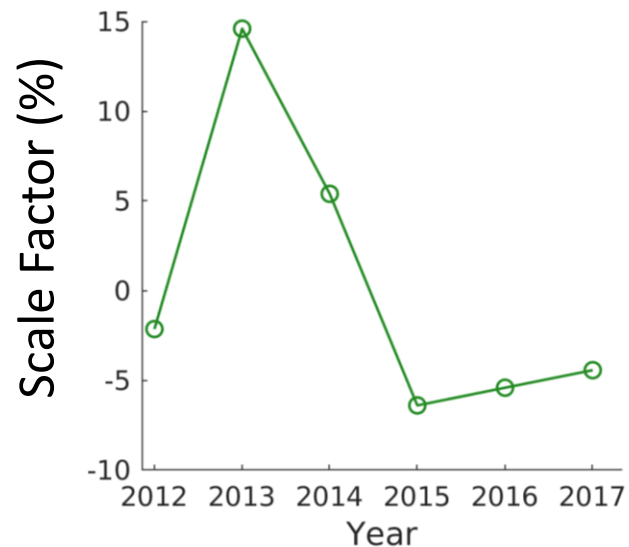
Diurnal profile varies by
day of week



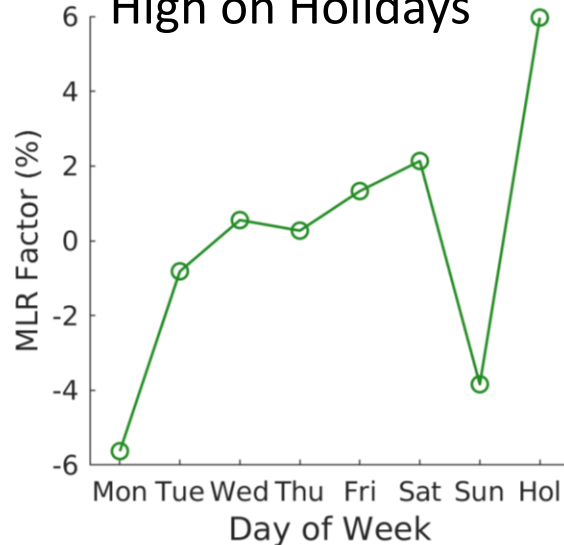
PM_{2.5} in Fresno, California: Winter Exceedances due to Stagnation Events



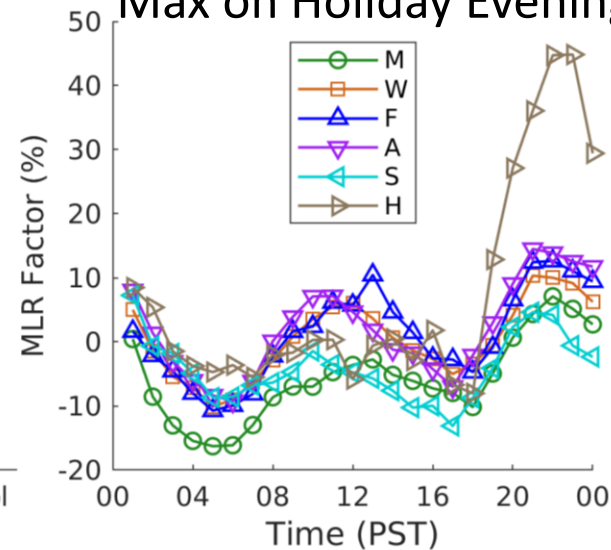
Check Before You Burn
Started in Nov 2014



PM_{2.5} Low on
Mondays & Sundays,
High on Holidays

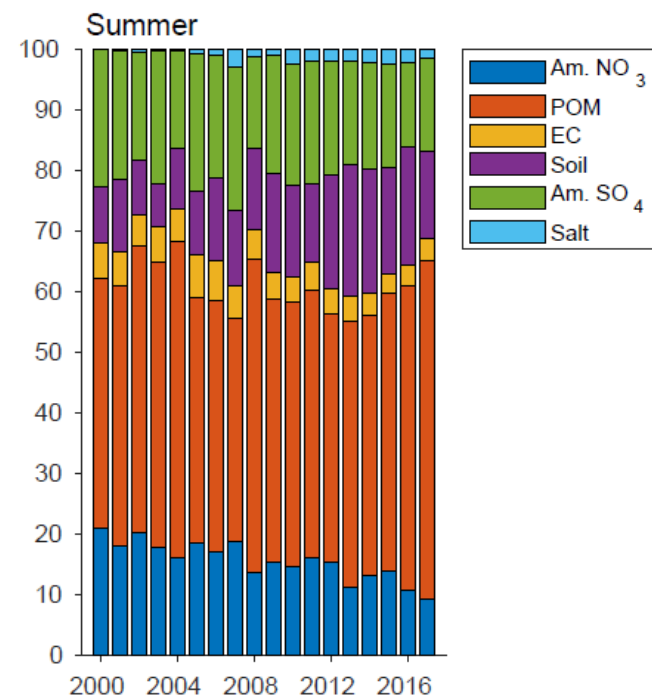
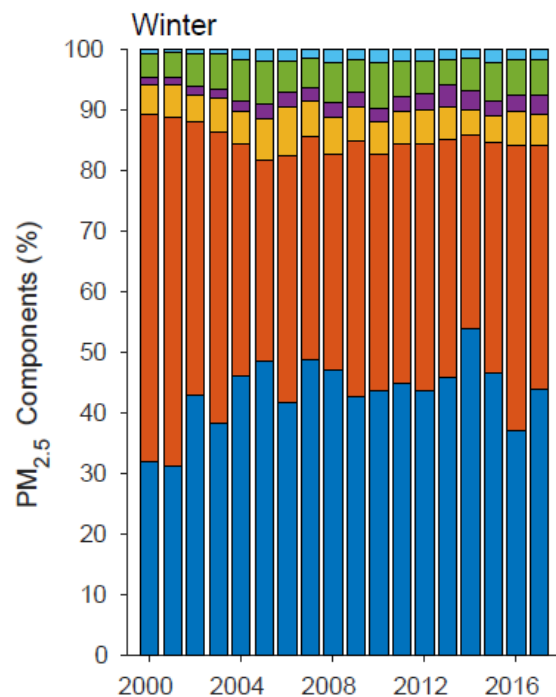
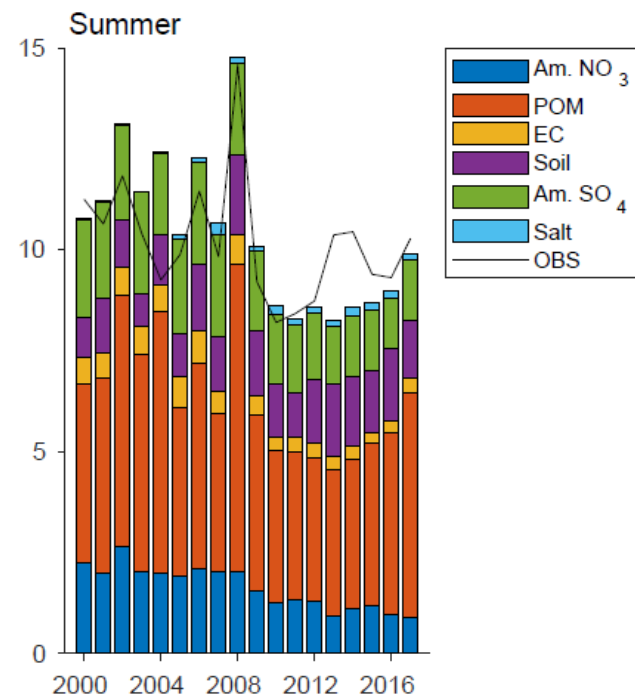
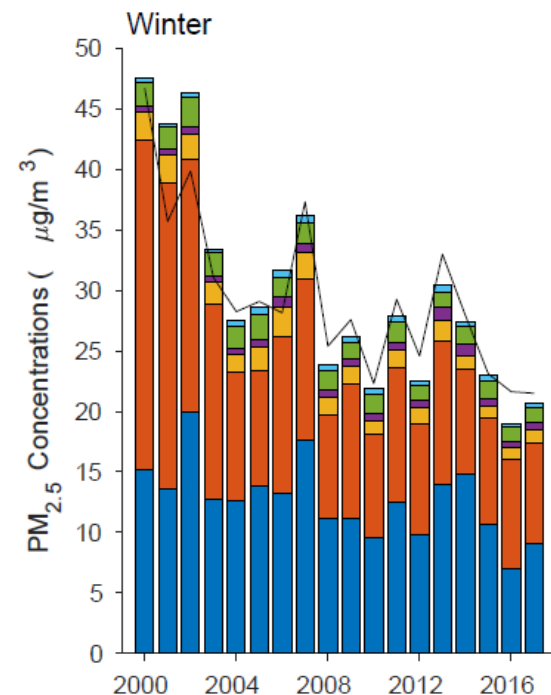


Both Daytime and
Nighttime Peaks,
Max on Holiday Evenings

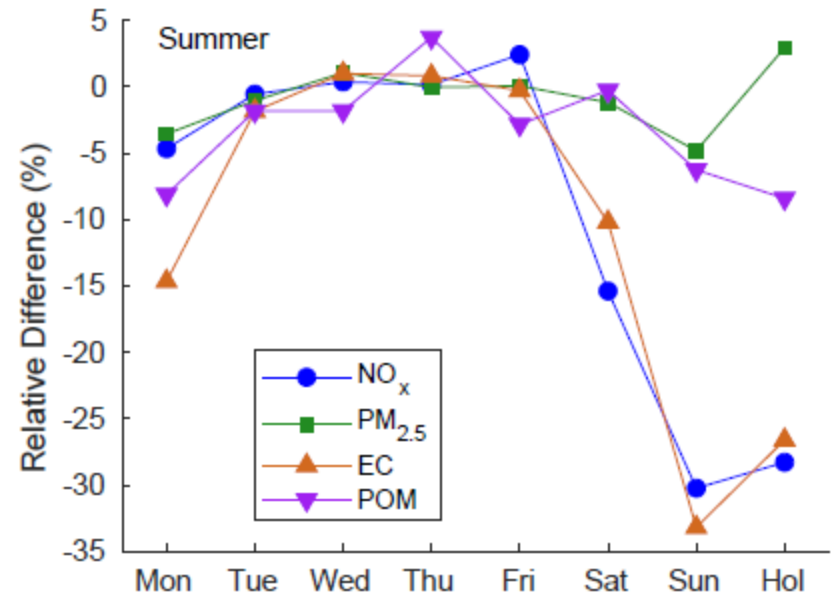
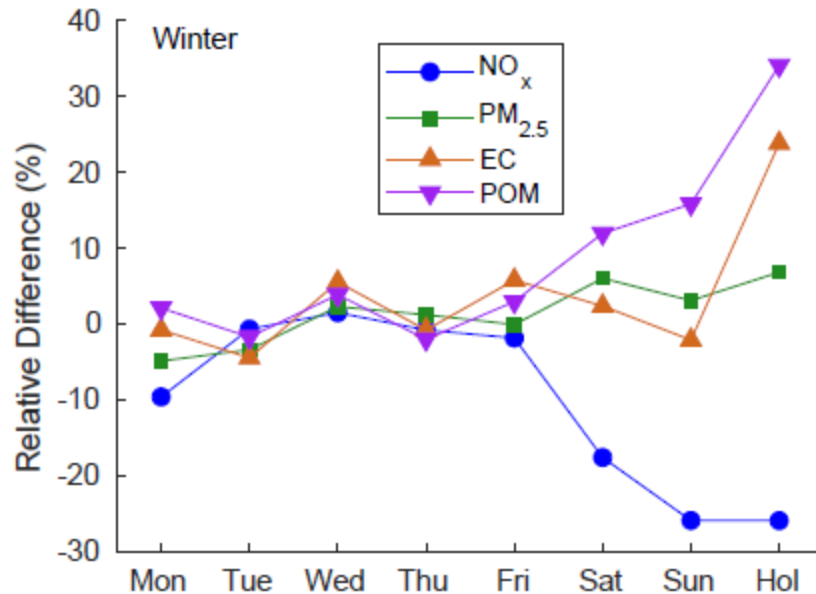
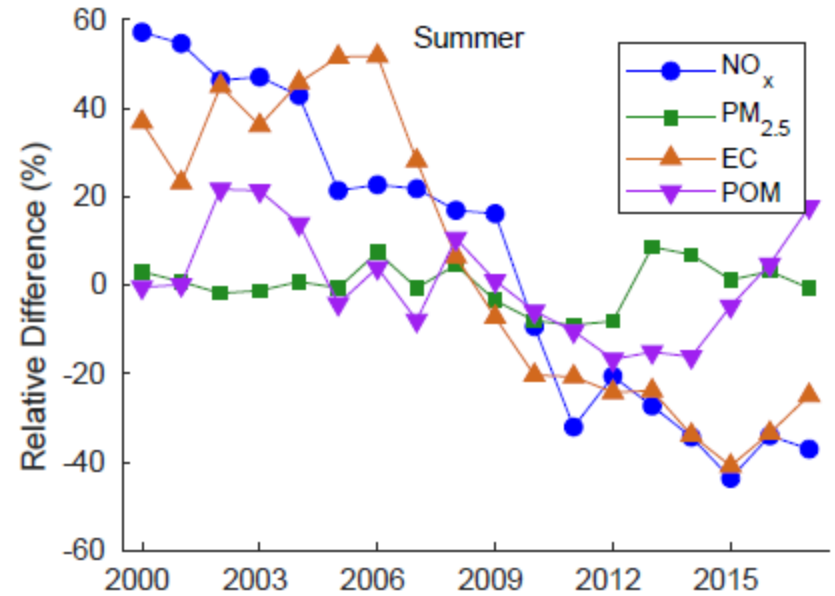
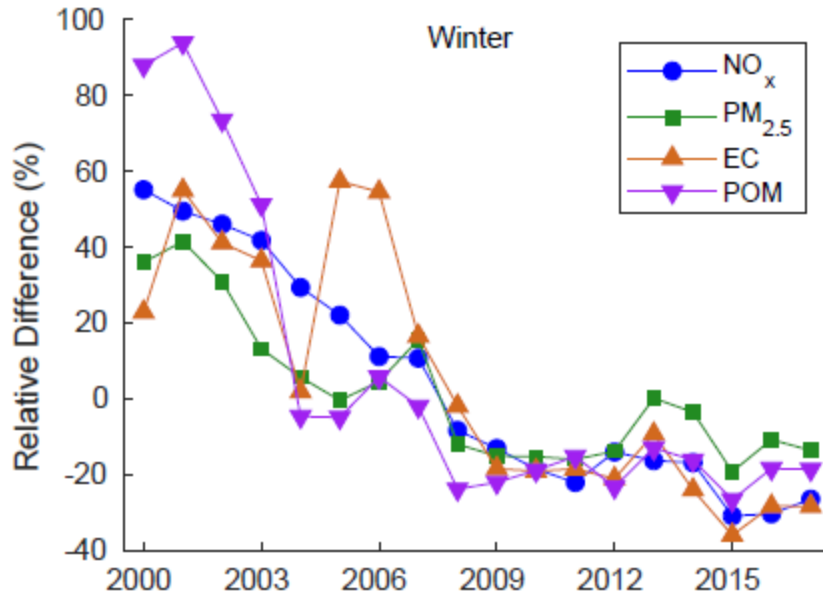


PM_{2.5} Fractions from Chemical Speciation Network Measurements at Fresno

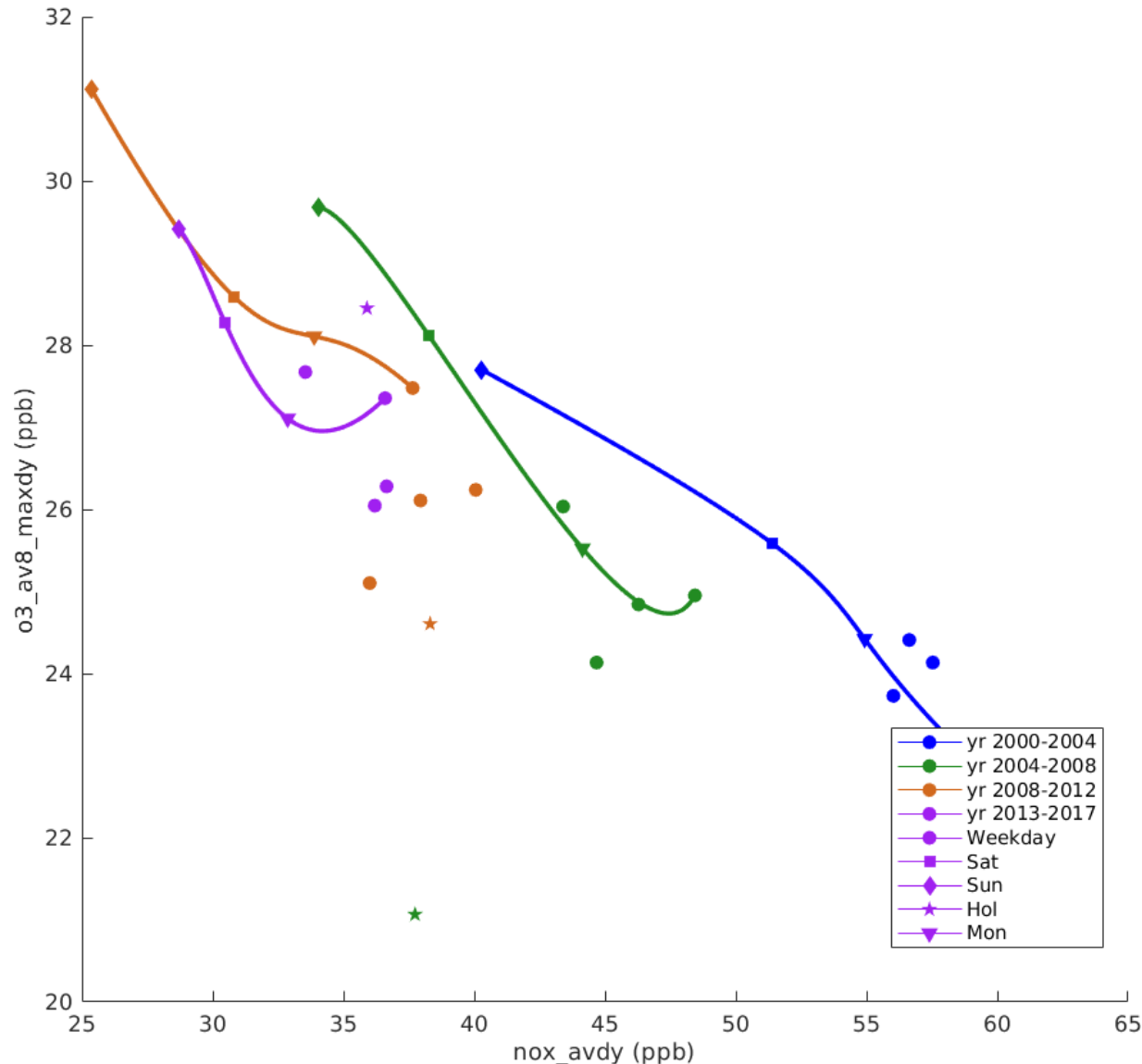
- Downward winter trend
- Variable/Increased Summer Particulate Organic Matter
- Reduced NO_x has led to reduced Elemental Carbon and Ammonium Nitrate
- Reduced Residential Wood Combustion has reduced fine aerosols



Annual and Weekday Patterns by Season tell us about emission sources



Scatterplot of Measured Av. Daily NOx vs. MDA8 O3 for coldest 33% of days by maximum daily temperature

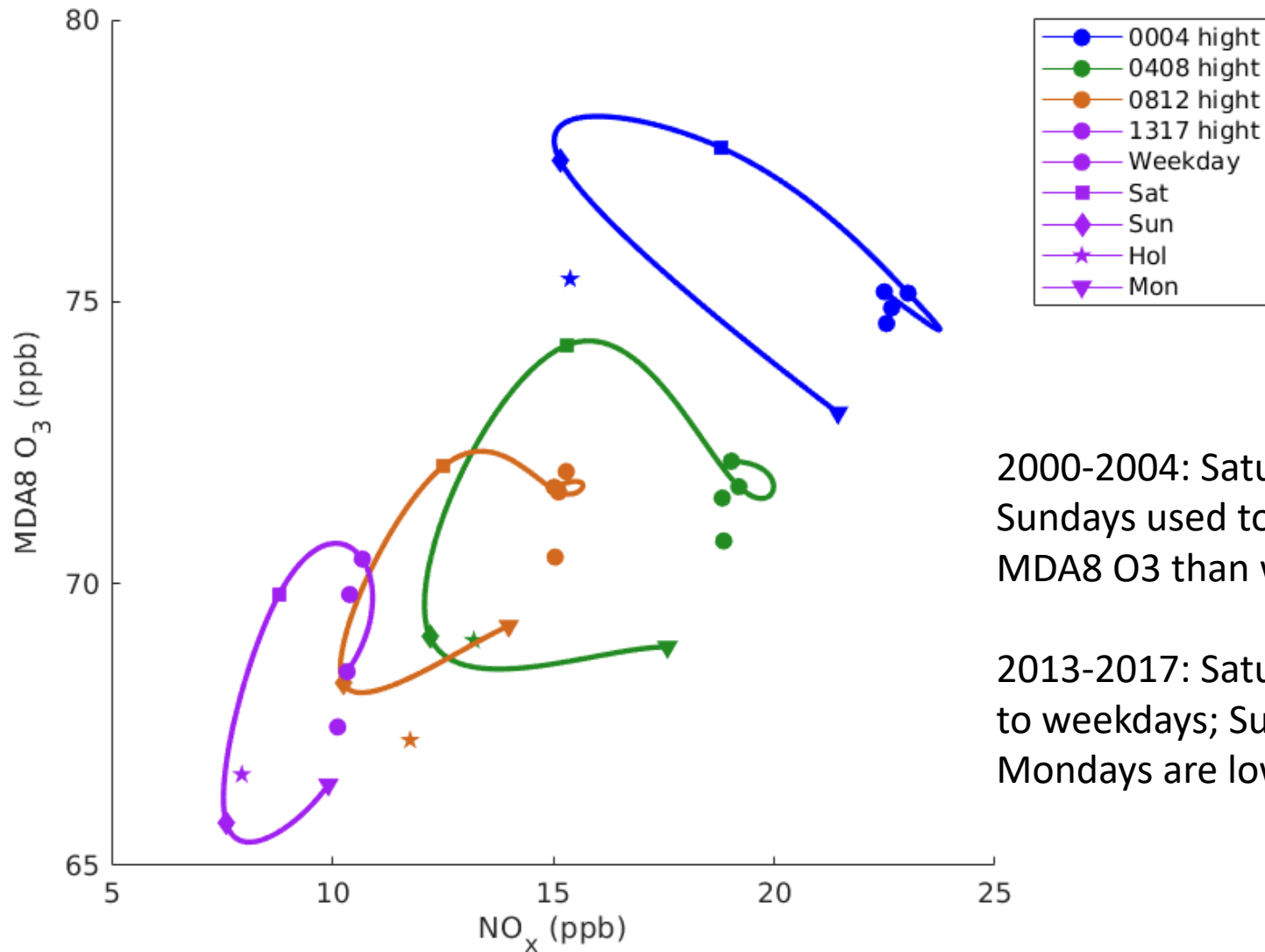


Average by year range and by day of week.

Trend to lower NOx and higher MDA8 O3 in recent years (purple).

Linear day-of-week trends shows that titration effects dominate.

Scatterplot of MLR Av. Daily NO_x vs. MDA8 O₃ for hottest 33% of days by maximum daily temperature



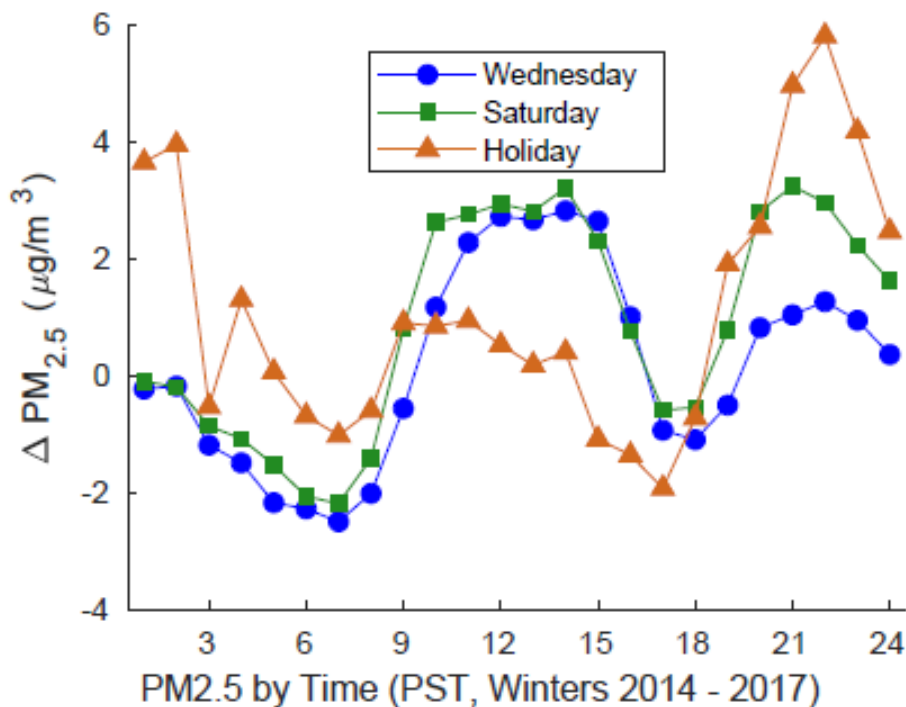
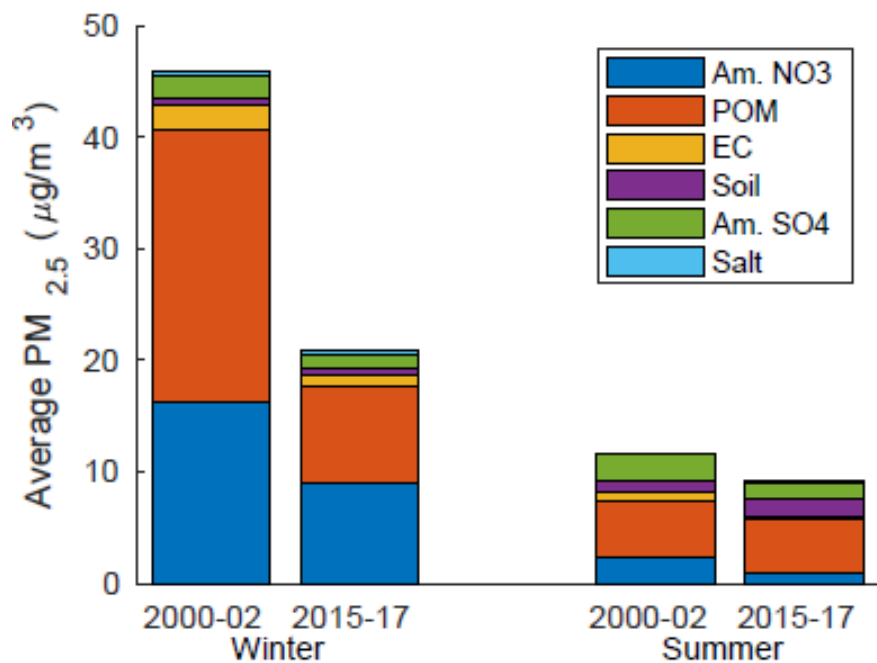
2000-2004: Saturdays and Sundays used to have higher MDA8 O₃ than weekdays.

2013-2017: Saturdays are similar to weekdays; Sundays and Mondays are lower.



Conclusions:

- Reduced Winter $PM_{2.5}$
- Summer Ammonium Nitrate and Sulfate are down, but Particulate Organic Matter is variable
- Week-end / Holiday effect: Increased $PM_{2.5}$ on festive evenings
- Week-end ozone effect: reduced O_3 on Sundays and Mondays



Extras